

OBSERVATIONS ON PERIPATUS.

BY THOS. STEEL, F.C.S.

The following remarks refer entirely to the ordinary New South Wales *Peripatus*, the form for which the name *P. Leuckarti*, var. *orientalis* has been proposed by Mr. Fletcher.*

For some years past I have taken a good deal of interest in this creature amongst other of the cryptozoic fauna of Australia; and having had numerous living specimens of all ages under constant observation in vivaria during a continuous period of over a year, I have thought that my observations would be of interest to naturalists.

In the course of a number of visits to the Moss Vale district during the summer of 1894-5, and again in 1895-6, I was successful in collecting a considerable number of specimens.

The most remarkable feature about my collection, apart from the unusually large number of individuals of both sexes secured, is the very interesting range of colour variation which it illustrates.

It is not my intention to enter into any details regarding classification or structure, but to give a statement of such facts in connection with the habits and life-history of the creature as I have observed; together with a few details of the individual range of colour, and the relative proportions of the sexes in the specimens collected.

The summer of 1894-5 was remarkable, in the district above mentioned, for the abundance of various cryptozoic forms of life, particularly land Planarians, and the conditions seem to have been peculiarly favourable for *Peripatus*, judging by the number of individuals which I observed.

The total number of adults which I collected in the Moss Vale district during that summer was 579, of which 390 were

* P.L.S. N.S.W. (2 Ser.) Vol. x. 186.

females and 189 males; that is 67 per cent. of the former and 33 per cent. of the latter. Besides these a large number of young, ranging from newly born upwards, were noticed.

The summer of 1895-6 having been preceded by a prolonged spell of very dry weather, the organisms mentioned were found to be very scarce. Where in the previous summer I found hundreds of land Planarians, only scattered individuals of the more hardy and common species were to be met with, and it was only by diligent searching over a somewhat wide area that I was able to secure a very moderate number of Peripati. Particular spots which I specially remembered as being where I met with plenty of specimens in 1894-5, in 1895-6 I found to be quite deserted or only very sparingly populated by Peripatus, while the other usual forms of life—with the exception of ants and termites, which seem to flourish under any conditions—were equally scarce in proportion. This collection, though a good deal smaller, contained much the same relative proportions of males and females, and a similar range of colour variation, as that made in 1894-5.

When collecting in 1894-5, whenever I saw young Peripati under logs I made it a rule to replace them in the position in which I had found them; and as I noted numbers of these logs I was able to examine them again in 1895-6. In many cases where I had left large numbers of young of various ages I found on my second visit not a trace of any, and in others only a few.

My friend, Mr. C. Frost, F.L.S., informs me that in Victoria, where the summer of 1895-6 was similar to that experienced in New South Wales, he found the land Planarians exceedingly scarce, and in some cases altogether absent, in districts such as Fern Tree Gully, which are known to be usually prolific in these forms of life.

Such dry conditions, and the attendant "bush fires," must cause an enormous mortality amongst these lowly creatures, and it is greatly to be desired that as much information about them as is possible should be gained, as many local forms are certain to be now rapidly approaching extermination.

In the favourable summer of 1894-5, the individual adult Peripati ranged very much larger in size than was the case in 1895-6. The dry conditions of the latter period appeared to have stunted the growth of the creature. In 1894-5 large numbers of females were $1\frac{1}{2}$ inches in length when crawling, not counting the antennæ, and the males 1 inch; while in 1895-6 the longest female seldom exceeded 1 inch and males about $\frac{3}{4}$ inch. These are the dimensions when crawling naturally, and not when stretched to the fullest extent. What became of the large sized individuals of 1894-5, I cannot say. They may have perished, or could they have shrunk in size as a result of the unfavourable conditions? Whatever may be the cause, their absence was very marked.

In his account of the Mammalia of the Horn Expedition,* Professor Spencer gives exceedingly interesting information on the effect of the prolonged spells of arid conditions on the bodily development of some of the mammals of that region; and of the remarkable manner in which, on the other hand, they respond to the more favourable state of matters when a wet period intervenes.

A somewhat analogous series of observations is quoted in *Nature* from *The Entomologist*,† in which Standfuss, of Zurich, has investigated the effect on the dimensions, and on the patterns and colours of the wings of certain butterflies; of the subjection of the eggs, larvæ and pupæ to various periods of exposure to different conditions of heat, cold, and moisture. Amongst other results arrived at was this, that the effect of abnormal heat on the larva was to hasten the development, but to cause a notable reduction in the size of the wings.

A very noticeable peculiarity was the intensely local nature of Peripatus. Considerable numbers would be met with in a very restricted area, and without any apparent cause none at all, or very few, would be found on precisely similar ground adjoining.

* Account of the Horn Expedition to Central Australia, Part 2, 1896.

† "Nature," Vol. liii., 540, April, 1896.

After a little experience I got to know the likely-looking parts, and even the most promising logs under which to search. All the specimens were underneath logs, either on the ground or on the undersurface of the log, and in the cracks and crannies in the soil beneath the logs. Small easily rolled logs yield the best results for *Peripatus* as well as for land Planarians and the other creatures that live under them; large heavy ones lie too hard and close to the ground, and do not give the necessary room underneath.

The colours of the individuals were exceedingly variable. Adopting a similar method of comparison to that used by Mr. Fletcher* in his description of the collection made by Mr. Helms at Mt. Kosciusko, my specimens very naturally divide themselves into four groups:—*a.* Black or blue-black. *b.* Black, sparingly speckled with rufous brown. *c.* Rufous brown with black antennæ and with or without visible scattered black spots or specklings. *d.* Entirely rufous brown or red, including the antennæ, and without any visible black.

The relative numbers of individuals in each of these classes was:—

<i>a.</i> Black or blue-black	77½ per cent.
<i>b.</i> Black, speckled with brown	...	6½	„ „
<i>c.</i> Brown, black antennæ	...	10	„ „
<i>d.</i> Entirely brown	...	6	„ „

In the Mt. Kosciusko collection the proportion of entirely black individuals is very much smaller than the above, amounting to only about 9 per cent. of the whole, the greater number being dark, sparingly speckled with brown.

No specimens with antennæ and body both entirely brown are mentioned, and indeed, judging from the published descriptions and my own experience, this particular form appears to be much less common than the others. Such being the case, it may be well for me here to briefly describe those in my collection. To the naked eye or the microscope there is no trace of black visible. The lozenge-shaped pattern which has been so fully treated of by

* P.L.S. N.S.W. (2 Ser.) Vol. v. 471.

Fletcher and Dendy, while quite distinct, is not nearly so boldly outlined as is commonly the case in *P. oviparus*, Dendy; it is marked out by alternate light and dark areas of skin, the pattern being entirely due to differences in intensity of the brown pigment. This form of *Peripatus* is exceedingly beautiful; it is a very striking object, and from its bright colour, much more conspicuous than its black brethren. When a number of specimens of the brown form are put in spirit together, I have noticed that the latter acquires a distinct brown tinge, which would show that the colour pigment, like that of land Planarians, is to some extent soluble in alcohol.

Most if not all of the specimens which to the eye or the pocket lens appear quite black, under the microscope present numerous scattered skin papillæ and minute patches of the skin of a brown colour. The antennæ appear to be the last part to lose the black pigmentation or the first to gain it, whichever the case may be. It very commonly happens that the entire body may be brown and the antennæ alone black, and I have not observed a specimen having entirely brown antennæ which had black on any part of the body.

This recalls to my mind a matter in connection with dogs which I have noticed for many years, that they invariably have the tip of the tail white if there is white on any part of the body, and frequently the tail tip is the only white part.

It may also be noticed that in *Peripatus* the colour variations are pretty uniformly proportionately divided between the males and females.

The adult females are, in my experience, invariably larger than the males, the former being usually from $\frac{1}{3}$ to $\frac{1}{2}$ longer than the latter; and the females are also a good deal stouter in proportion to their size, the males being more slender.

The males are distinguishable under the microscope from the females by the white leg papillæ, when about 12 mm. in length, corresponding to about eight months old.

Judging from the rate of growth in captivity I think the females do not mature before they are over two years of age, and

it would appear very probable to me that the young are not born until the mother is at least three years old.

In life both blades of the jaws lie with their convex edges outwards, the outer simple bladed jaw lying close up to the inner toothed one, with the points close together. When feeding the jaws are moved very rapidly, with a circular sweep.

I have counted the claw-bearing legs of several hundreds of specimens, and have found them invariably fifteen pairs, exclusive of the oral papillæ. In living individuals the narrow white line in the centre of the dorso-median furrow, described by Prof. Dendy in *P. oviparus*,* and by Mr. Fletcher in *P. Leuckarti*,† is very readily seen under the microscope in the dark coloured specimens, and can be distinctly observed in the light brown ones also, especially when it crosses patches of the darker brown. In young ones it is even more conspicuous than in adults. In adults a somewhat similar line lies at the bottom of the numerous horizontal skin furrows which cross the median line, and indeed wherever there is a furrow in the skin its course is more or less distinctly marked out by white.

These lines are well seen when the animal is extended in the act of crawling, but when it is at rest they are closed over by the skin folds.

The food of *Peripatus* consists of insects, wood lice, and such-like. Termites are a favourite article of diet, and are eaten freely. All the soft parts are eaten, including the legs of small insects. The skin of the outer integument of such creatures as wood lice is scraped completely off. Its feeding, as one might expect from the nature of its jaws, is by no means confined to sucking the juices of its prey, but all parts, save the hard integument, are devoured. Of Termites only the hard part of the head is rejected, the remainder, including the antennæ, being entirely eaten.

* P.L.S.N.S.W. (2 Ser.) x. 196.

† Ibid. 183.

It is rather interesting to observe the behaviour of wood lice, the creatures with which I have most frequently fed my Peripati, when dropped into the vivarium. At first they scramble under the little pieces of rotten wood, under which the Peripati are lurking, but they very quickly appear to recognise the presence of an enemy and crawl out again, finally clustering together as far as they can get from their foes. Wood lice eat any sort of organic matter, vegetable or animal, and I have seen one biting and nibbling at a sickly Peripatus which was too weak to defend itself.

I have never observed Peripati eat one another; even when kept without food they do not attack each other or the young.

When feeding the movements of the animal are very graceful and deliberate. The antennæ are endowed with a high degree of sensitiveness, and are used by cautiously touching the insect, when so occupied being carried somewhat erect with the tips curved downwards. From the manner of using them sometimes, by bending them round and over an object which is being examined, without touching it I think it is highly probable the antennæ are the medium of a sense analogous to that of smell.

In securing its prey Peripatus does not always use the slime secretion, but appears to resort thereto only when the insect which it is endeavouring to secure appears likely to escape, or when it struggles violently, or again when the animal is hungry and wants to make certain of the capture. It then becomes animated, raises the front part of its body and ejects the viscid fluid from both papillæ simultaneously. The secretion is ejected with sufficient force to project it several inches. The slime appears to be of an albuminous nature. It is not at all acid or acrid, but is merely useful mechanically, through its tenacious stickiness. When freshly emitted it is rather liquid, but quickly toughens in the air. It is tasteless and has no effect when applied to a sensitive mucous surface of the human body. It mixes with water, but is at once coagulated and rendered insoluble by alcohol.

When the creature is alarmed by sudden exposure to light, the slime is often discharged, the object obviously being self-defence.

Peripatus is a very sociable creature. They do not molest one another, and love to crowd together in congenial lurking-places. I have often observed several of them around one insect feeding in perfect harmony.

Although they will readily feed on dead insects, I have not been able to induce them to eat raw or cooked meat. Occasionally one will after a long examination pull at the meat for a little while with its jaws, but very soon leaves it.

The skin is cast at apparently somewhat irregular intervals, but I have not observed how often. The earliest casting which I have noticed was in the case of young ones born in captivity, which shed the skin when between one and two weeks old. The skin splits along the median dorsal furrow, and is gradually worked off by expansive and contractile movements of the animal, the front end being first worked forward out of the skin and then the whole gradually crumpled off in a very perfect state, including that of the antennæ, feet, and appendages. The exuvia are pure white, the colour pigment being situated entirely in the inner skin layer which remains.

During the shedding of the skin, the operation is frequently assisted by the animal bending round and pulling at it with its jaws, and as soon as it is cast the skin is often eaten, being taken up by the mouth, worked about for a little while by the jaws, and then swallowed entire.

By watching the creatures I have been able to secure several specimens of the cast skins, and with a little careful floating on water have uncrumpled them and caused them to spread out to their full extent, when they form a very delicate and beautiful object. Examples of these, both young and adult, are amongst the specimens exhibited. The young appear to be usually born fully extended, but at times doubled up in a thin membrane. I am not sure, however, that in the latter case the birth is not somewhat premature. However, the newly-born young soon crawl about, though they generally remain about the mother for several days. When born they are nearly white, but the colour

pigment is plain on the antennæ and those parts of the skin which, in after life, are darkest. I have frequently witnessed the natural birth of the young, and have succeeded in keeping them alive for over twelve months. When newly born they are about 5 mm in length, without the antennæ, and from frequent measurements I have found the rate of growth during the 12 months which I had them under observation to be rather less than 1 mm. per month.

Pregnant females somewhat readily extrude the young when distressed by close confinement or uncomfortable conditions. Frequently soft adventitious eggs are laid. These bear no resemblance to those described by Dendy from *P. oriparus** but are quite smooth and have a very flaccid thin envelope. They very soon break up into a drop of turbid liquid. My supposition is that they are merely ova which have escaped fertilization, and are thus making their natural exit from the body.

From my own observations I have seen the young born at all times, from the middle of November till the middle of March. Females which I had in captivity from January, 1895, began to give birth to young at the former date, and continued doing so for over a month, while specimens collected in December, January and February of different years, had young in the course of these and the following months.

So far as my observations go, the young follow the colours of the mother. Mothers, in whom brown is the prevailing colour, have young of a similar character, and those that are black have dark progeny.

I have never noticed the presence of external parasites of any kind on *Peripatus*.

During the colder months they become sluggish, and remain for considerable periods without eating, but in the warmer part of

* P. L. S. N. S. W. (2 Ser.) x. 195.

the year they move about very freely at night, crawling all over the accessible parts of the vivarium in which they are confined, and in the day time hiding away in crevices and beneath lumps of earth or pieces of wood.

The kind of vivaria in which I have been most successful in keeping my specimens alive, consist of ordinary glass jam jars having metal lids, which slip or screw on not quite air tight. These are filled with lumps of moist earth and odd pieces of rotten wood. An arrangement such as this is very convenient for observation, and allows of taking out the contents when desired for examination, without injury to the specimens.